BUREAU OF WASTE PREVENTION
DIVISION OF PLANNING AND EVALUATION

BACKGROUND DOCUMENT AND TECHNICAL SUPPORT FOR PUBLIC HEARINGS ON PROPOSED AMENDMENTS TO 310 CMR 7.00 et seq.:

310 CMR 7.29
"Emissions Standards for Power Plants"

Regulatory Authority:
M.G.L. c. 111, Sections 142A through 142N

October, 2003

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I. Introduction

In June of 2000, the Massachusetts Department of Environmental Protection ("DEP" or "the Department") released a Technical Support Document entitled *"Background Document and Technical Support for Public Hearings on Proposed Amendments to 310 CMR 7.00 et seq.: 310 CMR 7.29 – Emission Standards for Power Plants"* (hereafter referred to as the *" June 2000 Background Document"*) and proposed a regulation to lower emissions of harmful pollutants from power plants in order to further protect public health and the environment. This program was presented as the proposed new regulation 310 CMR 7.29. DEP held five public hearings, and solicited written comment on the proposed regulation.

After considering all of the written and oral comments received during the public comment period, the Department determined that emissions of sulfur dioxide, nitrogen oxides, carbon dioxide and mercury from the facilities affected by the proposed rule contribute, in combination with emissions from out of state sources and emissions from other, less easily controlled sectors of Massachusetts' emissions inventories, to a condition of air pollution in Massachusetts and northern New England. In April of 2001, the Department promulgated the final regulation, 310 CMR 7.29, Emission Standards for Power Plants,[1] in order to reduce emissions from the six affected facilities, and therefore, ease the condition of air pollution present in Massachusetts and northern New England. For more details on the final regulation see the *"April 2001 Statement of Reasons and Response to Comments for 310 CMR 7.29-Emission Standards for Power Plants,"* (hereafter referred to as the *"April 2001 Statement of Reasons."*)[2]

In order to control the mercury emissions, the final regulation caps mercury emissions from solid-fuel-fired affected facilities by limiting annual mercury emissions to the average annual emissions calculated using the results of required stack tests and fuel sampling (hereafter referred to as the "mercury emission cap"). At this time, the Department is proposing amendments to the regulation that further define how an affected facility should calculate its mercury emission cap. Section III.B. describes the details on the proposed calculations for the mercury emission caps at each facility.

The final regulation also provides a framework for establishing mercury emission standards for the affected facilities by requiring that the Department, by December 1, 2002, "complete an evaluation of the technological and economic feasibility of controlling and eliminating emissions of mercury from the combustion of solid fossil fuel in Massachusetts." See June 2000 Background Document and the April 2001 Statement of Reasons. The regulation also states, "within 6 months of completing the feasibility evaluation, the Department shall propose emission standards for mercury."

In December of 2002, the Department completed and published an *"Evaluation of the Technological and Economic Feasibility of Controlling and Eliminating Mercury Emissions from the Combustion of Solid Fossil Fuel,"* hereafter referred to as the *"Mercury Feasibility Report."*)[3] In the Mercury Feasibility Report, based on a wide range of research, data and

[1] http://www.state.ma.us/dep/bwp/daqc/files/regs/729final.doc

[2] http://www.state.ma.us/dep/bwp/daqc/files/regs/finalrsn.doc

[3] http://www.state.ma.us/dep/bwp/daqc/files/mercfeas.doc

experience, the Department concluded that there is strong evidence that the removal of 85-90+% of mercury in flue gas is technologically and economically feasible for coal-fired power plants at the present time.

At this time, based on the findings in the Mercury Feasibility Report, the Department is proposing amendments to 310 CMR 7.29, Emissions Standards for Power Plants, as part of a formal rulemaking process in accordance with M.G.L. Chapter 30A. Through this rulemaking process, the Department is proposing amendments to establish mercury emissions standards for fossil fuel fired units at the affected facilities and to establish the requirements for complying with the mercury emission standards. The Department solicits comments only on all provisions put forth in this proposal, and not on matters previously proposed in June 2000 and decided with the issuance of 310 CMR 7.29 in May 2001. Once comments are received, the Department will prepare and issue final amendments to the regulation and responses to all relevant comments received during the comment period.

II. Background on Mercury

A. Health and Environmental Effects from Mercury Emissions

Mercury is a persistent, bioaccumulative toxic metal that exists as a trace metal in the earth's crust. Mercury is released to the environment from airborne emissions, direct discharges to surface water and soil, accidental spills, and natural activities. Although all releases of mercury are of concern, air emissions play a significant role in the transport and dispersion of mercury.

Once mobilized in the environment, mercury can be transported long distances and undergo several chemical transformations while cycling through land, water, and air. Methylmercury, one particularly toxic form of mercury, bioaccumulates in fish and can be ingested by fish-eating animals and humans. Exposure to methylmercury can impair the human nervous system, and kidney function, and can cause tingling in the limbs; exposure to methylmercury in *utero* can cause neonatal brain damage, and cause developmental effects in children.

Levels of mercury in the environment are high across Massachusetts and the northeast. Over 60% of Massachusetts lakes and ponds have fish that are unsafe for pregnant women and children to eat because of mercury. The Massachusetts Department of Public Health recommends that pregnant and nursing women, women who may become pregnant and children under 12 avoid eating any native freshwater fish caught in Massachusetts as well as several species of saltwater fish. Data from a national exposure assessment by the US Centers for Disease Control (CDC) indicate that about *8% of women of childbearing age* are being exposed to mercury at a level above that recommended by USEPA and the National Academy of Science (equating to an impact on *over 350,000 newborn babies each year)*. Almost 40% of the lakes and ponds tested in Massachusetts have fish with levels of mercury that are unsafe for all humans. All Northeast states are affected.

Evidence of elevated rates of mercury deposition and of high levels of mercury contamination in freshwater fish taken from waterbodies throughout Massachusetts, the US and Canada has prompted widespread concern about health and environmental impacts. In addition, several studies in Maine and Russia have shown that acidification of surface waters increases the

bioavailability of some metals, like mercury, to fish.[4] In response, many states nationwide, including all the Northeastern states and three eastern Canadian provinces, have issued fish consumption advisories recommending limits on the consumption of contaminated fish. Over the past several years, Massachusetts has issued fish consumption advisories for over 100 waterbodies because of the mercury levels measured in fish tissue.

Mercury is used in a number of common consumer products, such as thermometers, fluorescent lights, thermostats, and certain batteries. In addition, mercury is present as a trace element in oil and coal, and is emitted during combustion of these fuels. The primary anthropogenic sources of mercury emissions worldwide include coal combustion, mining and smelting, industrial processes, and municipal waste incineration.[5] A 1996 inventory of Massachusetts facilities suggests that coal and oil-fired generators were responsible for approximately 30% of the mercury emissions in the state at that time.[6]

Mercury releases, because of its toxicity and its being a trace metal in fuels, are measured in pounds per year, as compared to other pollutants (e.g., SO_2, NO_x) that are measured in tons per year. The following simplified examples provide some perspective on this issue:

- Massachusetts' Department of Public Health recommends that pregnant women and children not eat fish containing 0.5 ppm of mercury; these fish contain less than 1/100,000 of an ounce of mercury per pound.
- Research on mercury inputs to lakes and ponds in Minnesota indicate that fish can be contaminated to unsafe levels by the annual deposition of only about 1 gram of mercury (a fraction of an ounce or about the amount in a fever thermometer) per 20 acres[7]. Air deposition rates of mercury in New England are consistent with those reported for Minnesota (http://nadp.sws.uiuc.edu/mdn/maps/2001/01MDNdepo.pdf), and have similarly resulted in fish consumption advisories across the region.

Summarizing the available data on mercury toxicity in wildlife, EPA has indicated that sublethal effects can occur at doses as low as 0.25 micrograms per gram of bodyweight per day, or a dietary concentration of 1.1 ppm, and that death can occur in some species at doses ranging from 0.1 to 0.5 micrograms per gram of bodyweight, or at a dietary concentration from 1 to 5 ppm.[8] Reductions in anthropogenic mercury emissions would benefit the Northeast region by decreasing the available mercury for methylation and uptake in local fish populations. Over time, reduction in emissions will result in lower methylmercury levels in fish and lower exposure rates to people and animals that consume freshwater fish.

B. The Role of Utility Mercury Emissions in the Overall Mercury Inventory

The following two charts portray estimates of the Massachusetts mercury ambient air emissions inventory for point and area sources. The values on the area source chart represent the range of

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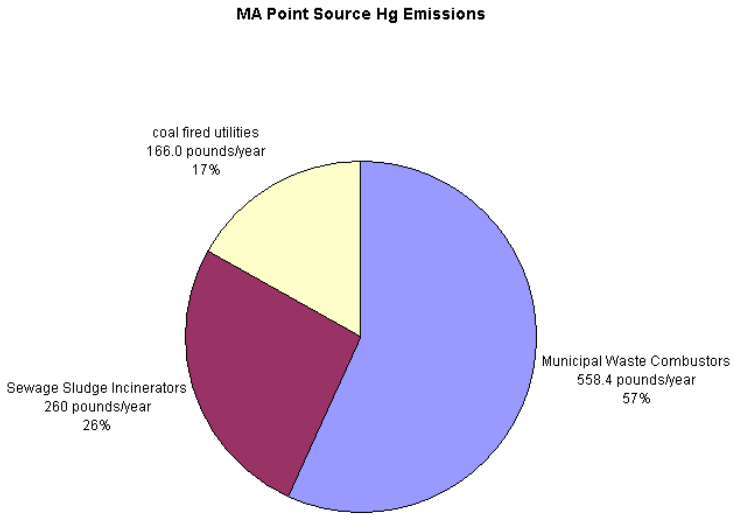
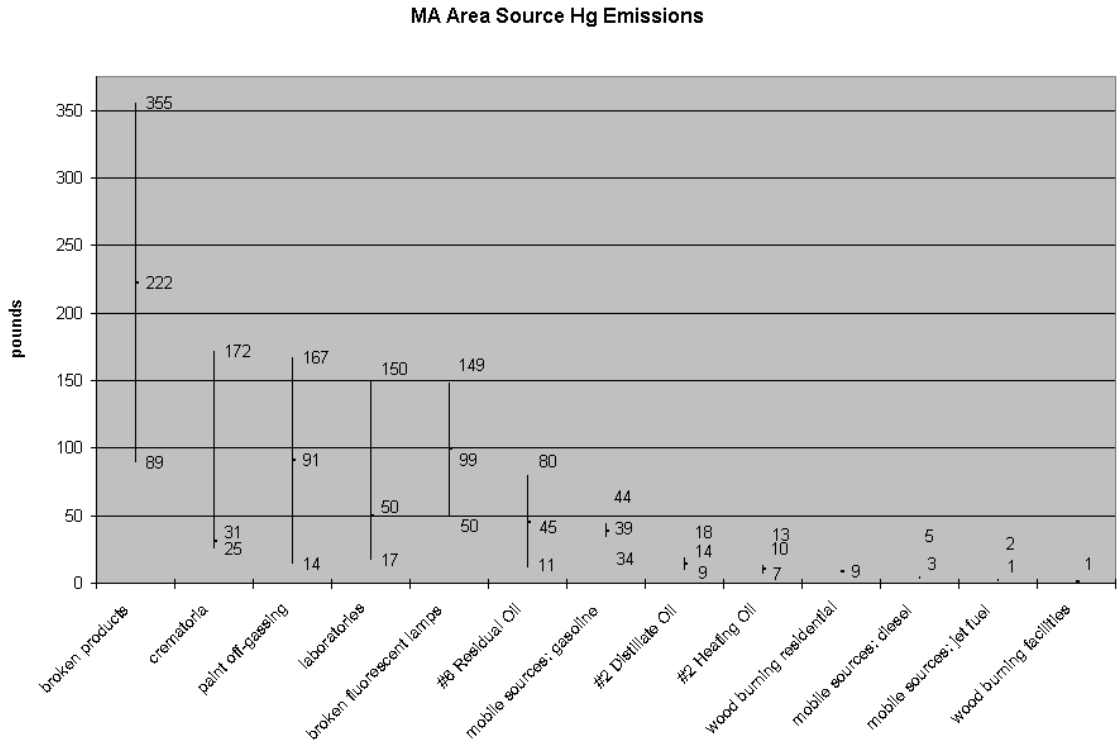
[4] Haines, Terry, and Brumbaugh, William. "Metal Concentrations in the Gill, Gastrointestinal Tract, and Carcass of White Suckers in Relation to Lake Acidity." *Water, Air, and Soil Pollution*. Vol. 73: 265-274. 1994.
[5] US EPA. "Mercury Report to Congress." 1997. http://www.epa.gov/airprogm/oar/mercury.html
[6] Massachusetts Department of Environmental Protection. "Mercury in Massachusetts: An Evaluation of Sources, Emissions, Impacts, and Controls." June, 1996. See: http://www.state.ma.us/dep/files/mercury/hgexsum.htm
[7] Swain, E.B., et. al., 1992, "Increasing Rates of Atmospheric Mercury Deposition in Midcontinental North America", Science, 257: 784-787.
[8] US EPA. "Mercury Report to Congress." 1997. http://www.epa.gov/airprogm/oar/mercury.html

estimates for each sector, with the middle value representing either the mid-point or most likely estimate.





The major point sources of mercury pollution include Municipal Waste Combustors, Sewage Sludge Incinerators, and coal fired utilities.

Municipal Waste Combustors (MWCs) are estimated to have emitted 558.4 pounds of mercury in 2002. This value includes 6 large and 2 small MWC facilities. Large MWCs are subject to strict mercury emissions standards under 310 CMR 7.08(2) and have reduced their mercury emissions by over 90% over the past five years[9]. The mercury emissions from this sector will significantly decrease as the MWC facilities continue to implement material separation plans, as required under the regulation, that will remove mercury containing products from the waste stream prior to combustion. One smaller MWC in western Massachusetts will also be installing carbon injection in the next year, which will reduce its mercury emissions. Additionally, many pollution prevention efforts are being implemented to further reduce mercury emissions by reducing the unnecessary use of mercury in new products. These efforts will result in further significant reductions in MWC mercury emissions, perhaps to below 100 pounds per year, from these facilities in the future.

Currently, Medial Waste Incinerators (MWIs) contribute 0 pounds of mercury emissions per year due to the shut down of all MWIs in Massachusetts. The last Massachusetts MWI shut down July 20, 2003. Thus, mercury emissions from MWIs have been reduced by 100%.

Sewage Sludge Incinerators (SSIs) are estimated to emit 260 pounds of mercury per year. The primary strategy for reducing emissions from SSIs has been Pollution Prevention, i.e., removing mercury from the source prior to discharge into the sewers. In Massachusetts, the primary target of this strategy has been capture of dental amalgams in wastewater through voluntary installation of amalgam separators in dentists' offices. Massachusetts's STEP program has conducted an assessment of separator technologies demonstrating their effectiveness at reducing mercury releases from the dental sector, which are likely to account for 25-40% of sewage mercury inputs. Legislation requiring use of amalgam separators has been introduced in the Massachusetts legislature. Many states and municipalities outside Massachusetts are mandating amalgam separator installation.

Coal fired utilities in Massachusetts emitted approximately 166.0 pounds of mercury in 2002. This value represents emissions for that specific year, and can be compared to the mercury cap of 185.0 pounds discussed in section III.B., which is calculated as a three-year historic average. Emissions from coal-fired utilities remain unregulated except for the current requirements in 310 CMR 7.29. Possible future federal regulations for this sector are discussed in section II.C. of this document. Mercury emissions from Massachusetts coal-fired utilities have not been reduced in the 5 years since the New England Governors and Eastern Canadian Premiers' Mercury Action Plan was adopted. In the absence of mercury regulations (such as those proposed here) for the coal fired utility sector, this sector has become an increasingly large part of the mercury emissions inventory, as other sectors come under control. The SO2 and NOx controls being installed at coal-fired facilities subject to 310 CMR 7.29 may result in avoided mercury emissions or in mercury removal co-benefits for these facilities, although these potential emissions benefits are not certain in the absence of a regulation establishing mercury standards. Without a standard, facilities would have no incentive to optimize SO2 and NOx controls for mercury removal.

The major area sources of mercury pollution include oil combustion for heating purposes, electricity generation and manufacturing and releases attributable to mercury-containing products. The nature of this sector, including the numerous units of small size, diverse boiler

[9] Based on stack tests and the closure of two MWC facilities.

designs and dispersed location, makes it difficult to develop options for controlling mercury emissions. For the manufacturing sector, most of the efforts for controlling mercury have focused on pollution prevention efforts to eliminate mercury from product design, such as the elimination of mercury from batteries and the manufacture of mercury-free thermometers.

Mobile sources (i.e., diesel fuel and gasoline) are currently being studied by EPA, Environment Canada and the University of Michigan to estimate mercury emissions and potential control options. Mobile sources may be a significant overall mercury emissions source. There may be additional mercury releases associated with other automotive fluids.

C. Existing Work by EPA and Other States to Establish a Mercury Emission Standard.

Because there were no limits on air emissions of mercury from power plants in the U.S. prior to the adoption of 310 CMR 7.29, the electric utility industry has not had a strong incentive to control mercury emissions. However, there are currently a number of initiatives underway that are aimed at reducing mercury emissions from power plants, which, like the Massachusetts regulation, will provide incentive for further development of control technologies.

In December 2000, EPA made a finding that the regulation of hazardous air pollutant emissions from electric utility steam generating units is necessary and that mercury is the hazardous air pollutant with the greatest potential concern for public health.[10] At that time, EPA added coal-and-oil-fired electric utility steam generating units to the list of source categories in section 112(c) of the Clean Air Act for which "maximum achievable control technology" (MACT) regulations must be developed. In a court-approved settlement of a lawsuit in which the Natural Resources Defense Council sued EPA over hazardous power plant pollution, EPA has agreed to propose the utility MACT regulations by December 15, 2003 and promulgate a final regulation by December 15, 2004 with a compliance date of December 15, 2007.

EPA indicates that it expects to propose and finalize a MACT regulation for power plants according to this timeframe. At the same time, the Bush Administration has proposed legislation that would limit the emissions of SO_2, NO_x and mercury from power plants and replace the utility MACT rule requirement with a nation-wide mercury cap and trade program. In the face of uncertain federal requirements, the Department plans to move forward with proposing a standard. In support of the MACT development process, EPA undertook an evaluation of the mercury control performance of various emission control technologies that are either currently in use on coal-fired units for pollutants other than mercury or that could be applied to such units for mercury control. DEP's review and assessment of available control technologies draws heavily on EPA's evaluation, as discussed below in section III.A.

Other states, including CT, FL, IL, MD, MI, MN, NH, NY, NJ, NC, OH and WI are all studying, measuring, or regulating mercury emissions from electric generating units. On May 5, 2003, CT approved a law that requires coal-fired plants to achieve a minimum of 90% mercury removal (or maximum 0.6 pounds of mercury emitted per-trillion Btu input, which is equivalent to 0.005-0.007 pounds per Gigawatt-hour) by a compliance date of July 1, 2008 and required CT DEP to consider a more stringent limit by July 1, 2012. The Wisconsin Natural Resources Board passed a rule requiring a 40% reduction from 2002-2004 levels by January 1, 2010 and an 80%

[10] See EPA Utility Air Toxics Study Report to Congress at: http://www.epa.gov/mercury/actions.htm#utility and EPA December 14, 2000 Fact Sheet at http://www.epa.gov/ttn/oarpg/t3/fact_sheets/fs_util.pdf.

reduction by January 1, 2015. The Wisconsin Legislature has asked the Board to re-assess some issues and return it to the Legislature for re-consideration. NJ plans to propose a mercury rule this fall.

III. Description of the Proposed Mercury Emissions Standards for Affected Facilities

The Department is issuing for public comment the proposed regulatory revisions to 310 CMR 7.29 which are attached as Appendix A. Specific issues upon which the Department seeks public comment are discussed below.

A. Mercury Emission Standards

The draft regulation contains a 2-phase standard and compliance timeline, and allows an "alternative reduction plan" for off-site mercury reductions to provide initial flexibility to the affected facilities during the time frame when they will be testing and optimizing newly installed SO2 and NOx controls. See section III.D. below for more details on the Alternative Reduction Plan.

- Phase 1 - By October 1, 2006, 85% mercury removal efficiency or a mercury emissions limit of 0.0075 lbs/GWh_{net}.
- Phase 2 - By October 1, 2012, 95% mercury removal efficiency or a mercury emissions limit of 0.0025 lbs/GWh_{net}.

The proposed phase 1 standard provides a choice for an affected facility of either: a minimum 85% removal of mercury from inlet levels measured in 2001-2002 or a maximum mercury emission limit of 0.0075 pounds of mercury per net gigawatt hour of electricity generated. This standard would take effect October 1, 2006, with the first annual average calculated for the October 1, 2006 to September 30, 2007 period.

The proposed phase 2 standard provides a choice for an affected facility of either: a minimum 95% removal of mercury from inlet levels measured in 2001-2002 or a maximum mercury emission limit of 0.0025 pounds of mercury per net gigawatt hour of electricity generated. This standard would take effect October 1, 2012, with the first annual average calculated for the October 1, 2012 to September 30, 2013 period.

The inlet levels measured in 2001-2002 are used as the basis of the removal standard so that a facility cannot increase overall emissions by meeting the removal efficiency standard based on a higher inlet measurement.

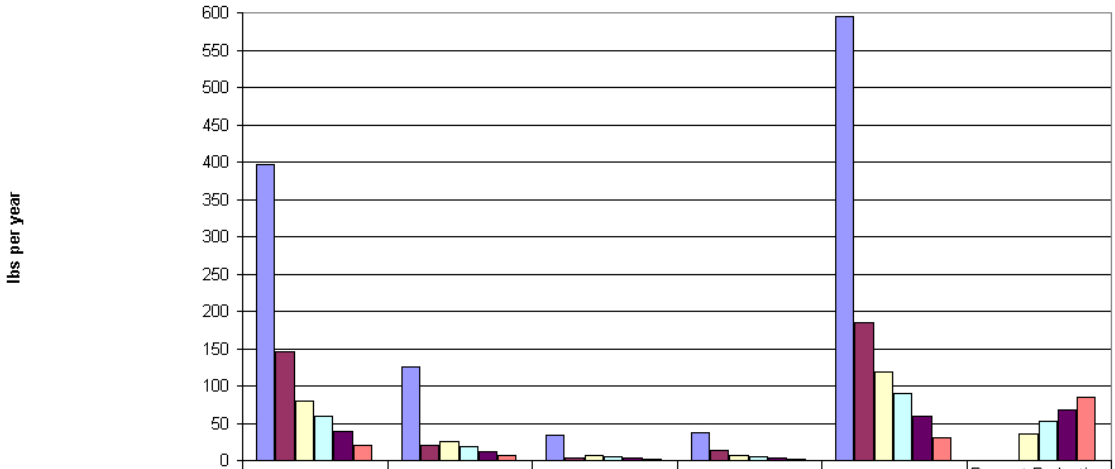
The Department requests comment on:
Whether the levels of the proposed mercury standards are appropriate.
Whether the compliance dates of the proposed mercury standards are appropriate.
Whether the Department should propose a two-phase approach, or some other approach.
Whether the 2001-2002 inlet levels should be used as the basis for calculating removal efficiency.
Whether the calculations detailed in the regulation are appropriate to determine compliance.

1. Benefits of Reducing Mercury Emissions

The environmental impact of these proposed regulations would be an overall lowering of mercury emissions. Chart 1 and 2 below illustrate the reduction in mercury emissions expected to accrue due to establishment of the proposed mercury standards.

Resulting mercury emissions upon implementation of Phase 1 would be a greater than 50% decrease from the level of the mercury cap discussed in section III.B. Resulting mercury emissions upon implementation of Phase 2 would be an approximately 85% decrease from the level of the mercury cap discussed in section III.B.

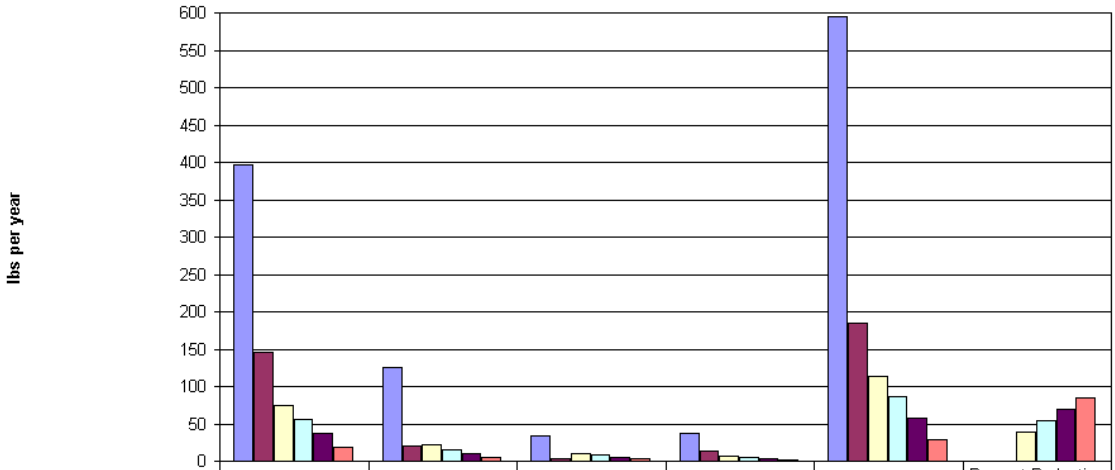
Chart 1. Quantity of Mercury Emitted Annually by Facility at Increasing Removal Efficiencies



	BP	SH	MT	NRG	MA TOTAL	Percent Reduction from 185 lbs
existing average inlet	396	126	34	38	594	
existing average outlet	147	21	4	13	185	
at 80% removal efficiency	79	25	7	8	119	36
at 85% removal efficiency	59	19	5	6	89	52
at 90% removal efficiency	40	13	3	4	59	68
at 95% removal efficiency	20	6	2	2	30	84

Key: BP = Brayton Point, SH = Salem Harbor, MT = Mt. Tom, NRG = NRG Somerset

Chart 2. Quantity of Mercury Emitted Annually by Facility at Decreasing Emission Rates



	BP	SH	MT	NRG	MA TOTAL	Percent Reduction from 185 lbs
existing average inlet	396	126	34	38	594	
existing average outlet	147	21	4	13	185	
at 0.010 lb/GWh	75	21	11	7	114	38
at 0.0075 lb/GWh	56	16	8	6	86	54
at 0.005 lb/GWh	37	11	5	4	57	69
at 0.0025 lb/GWh	19	5	3	2	29	85

Key: BP = Brayton Point, SH = Salem Harbor, MT = Mt. Tom, NRG = NRG Somerset

2. Technological Feasibility of Mercury Controls

As stated previously in the Department's Mercury Feasibility Report, the Department is relying on a wide range of research, data and experience to assess the technological and economic feasibility of mercury control. Based on the following, the Department concluded that the removal of 85-90+% of mercury in flue gas is technologically feasible.

a. EPA's Mercury Information Collection Request (ICR) Data

To demonstrate the feasibility of mercury control to the levels in the proposed standard, the Department points to data collected by EPA in 1999 as part of a nation-wide effort to develop a database to support EPA's development of a MACT standard for power plants. The data collection effort, referred to as EPA's Mercury Information Collection Request (ICR), was designed to gather emissions data from plants representative of the US coal-fired power plant fleet. The US fleet was categorized by 1) combustion technology utilized, 2) type of coals combusted, and 3) control devices installed for PM, NO_x, and SO_2.

The Massachusetts coal-fired units subject to 310 CMR 7.29 employ pulverized coal combustion technology. A summary of EPA's Mercury ICR data from pulverized coal fired boilers is listed below in Table 1. The table further highlights the results from pulverized coal boilers by the type of coal combusted[11] and by the type of emissions controls installed.[12] The figures represent

[11] The coal-fired Massachusetts facilities subject to 310 CMR 7.29 combust bituminous coal.

[12] The pollution control measures included in the ECP approvals for the coal-fired Massachusetts facilities subject to 310 CMR 7.29, including control devices currently installed and control devices expected to be installed at those facilities to comply with the 310 CMR 7.29 NO_x and SO_2 requirements, are summarized in Appendix B.

the three-run average percentage of mercury removed by the installed control devices, calculated from the difference in mercury measured before and after the control devices. The results document that there are US facilities that currently achieve up to 98% removal of mercury from bituminous coal, the kind used by Massachusetts coal-fired facilities subject to 310 CMR 7.29.

Table 1. Mean mercury reduction for pulverized-coal-fired boilers.[13]

Post-combustion Emission Controls Used for Pulverized Coal Boiler		Average Total Mercury Emission Reduction (%)[(a)]		
		Bituminous Coal	Subbituminous Coal	Lignite Coal
PM Control Only	CS-ESP	36 %	3 %	-4 %
	HS-ESP	9 %	6 %	not tested
	FF	90 %	72 %	not tested
	PS	not tested	9 %	not tested
PM Control and Spray Dryer Adsorber	SDA + ESP	not tested	35 %	not tested
	SDA + FF	98 %	24 %	0 %
	SDA + FF + SCR	98 %	not tested	not tested
PM Control and Wet FGD System	PS + FGD	12 %	-8 %	33 %
	CS-ESP + FGD	75 %	29 %	44 %
	HS-ESP + FGD	49 %	29 %	not tested
	FF + FGD	98 %	not tested	not tested

Key: (a) Mean reduction from 3-run averages for each pulverized coal boiler unit in Phase III EPA ICR database.
CS – cold side; ESP – electrostatic precipitator; FF – fabric filter; FGD – flue gas desulfurization; HS – hot side; PM – particulate matter; PS – particulate scrubber; SDA – spray dryer adsorber; SCR – selective catalytic reduction

b. Massachusetts' Test Data

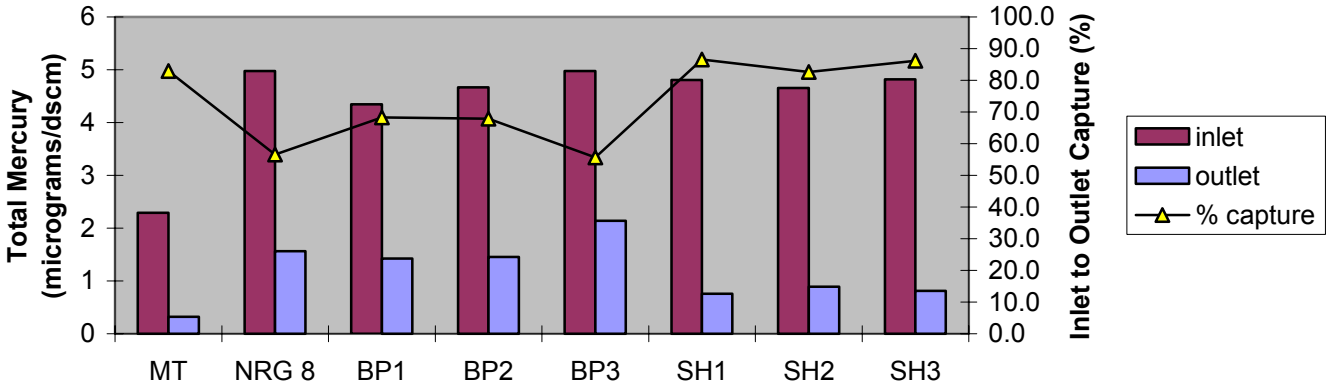
To demonstrate the feasibility of mercury control to the levels in the proposed standard, the Department points to results of testing required by 310 CMR 7.29,[14] which indicate that half of Massachusetts eight coal-fired units are achieving mercury removal rates approaching 90% due to existing emission controls and operating conditions.

310 CMR 7.29 required that each of the affected solid-fossil-fuel-fired facilities perform three sets of tests for mercury concentrations and species at two different points in the exhaust stream: 1) before all add-on air pollution control equipment (inlet), and 2) after add-on air pollution control equipment (outlet). This data is a snapshot of actual mercury emissions from each unit tested for the time period covered by the test (generally 2-3 days). Each of the three test sets consists of three runs, for a total of nine runs. The nine-run average amount of total mercury measured at the two required points and the calculated percentage of mercury removed by the installed control devices at Massachusetts coal-fired units subject to 310 CMR 7.29 is shown below in Chart 3. The results document that some Massachusetts coal-fired units are already achieving mercury removal rates approaching 90% with the existing emissions controls at the facility.

[13] Table from Office of Air Quality Planning and Standards, US EPA: Research and Development, "Control of Mercury Emissions From Coal-Fired Electric Utility Boilers: Interim Report Including Errata Dated 3-21-02," prepared by National Risk Management Research Laboratory, April 2002, EPA-600/R-01-109, pp. ES-10. http://www.epa.gov/ORD/NRMRL/Pubs/600R01109/600R01109.htm

[14] From emissions testing reports submitted to the Department to comply with 310 CMR 7.29(5)(a)3.d.

Chart 3. Average Total Mercury in Flue Gas by Unit



Key: MT – Mount Tom Station; NRG – NRG Somerset Station; BP – Brayton Point Station; SH – Salem Harbor Station

c. Field Tests of Mercury Specific Controls

To demonstrate the feasibility of mercury control using mercury-specific control technology, the Department points to the full scale pilot tests of sorbent-injection mercury control systems at Brayton Point Station and Alabama Power's Gaston facility, which have produced preliminary results of at least 90% mercury removal.[15]

Under the auspices of the Department of Energy (DOE) National Energy Technology Laboratory, studies of mercury control devices are occurring across the US. One study of particular relevance to Massachusetts includes testing at four facilities: Alabama Power's Gaston unit 3, Wisconsin Power's Pleasant Prairie unit 2, and two Massachusetts units subject to 310 CMR 7.29, i.e., Brayton Point unit 1 and Salem Harbor unit 1. The goals of the study are to:

- perform the first full-scale evaluations of mercury control on coal-fired boilers,
- evaluate the effectiveness of sorbent-based mercury control (e.g., activated carbon),
- test several different power plant configurations, and
- document all costs associated with mercury control.

A comparison of the Gaston, Pleasant Prairie, and Brayton Point preliminary results (similar data for Salem Harbor are not yet available) shown in Chart 4 below indicates that Gaston showed the highest percentage of mercury removal (i.e., 90+% removal) at the lowest concentration of sorbent injected (i.e., less than 5 pounds of sorbent per million actual cubic feet of flue gas (lb/MMacf)) for those three units for which preliminary data are available. This result is also reflected in cost data indicating Gaston has the highest mercury removal (i.e., 90+% removal) with the lowest sorbent costs at that removal level (i.e., under 0.5 mills/kWh). Gaston's impressive cost results are due in part to a PM control device (COHPAC) that requires less sorbent be injected to achieve a given mercury removal level than does a facility equipped only

[15] "Mercury Control Pilot Testing at Brayton Point Station," presentation at the Mercury Standards Technology Feasibility Meeting, Massachusetts Department of Environmental Protection, Boston, MA September 20, 2002, Richard Schlager, ADA Environmental Solutions.

with an ESP. Gaston was selected for the DOE sorbent-injection tests specifically because COHPAC represents a cost effective retrofit solution to improve particulate matter collection for utilities with existing ESPs.

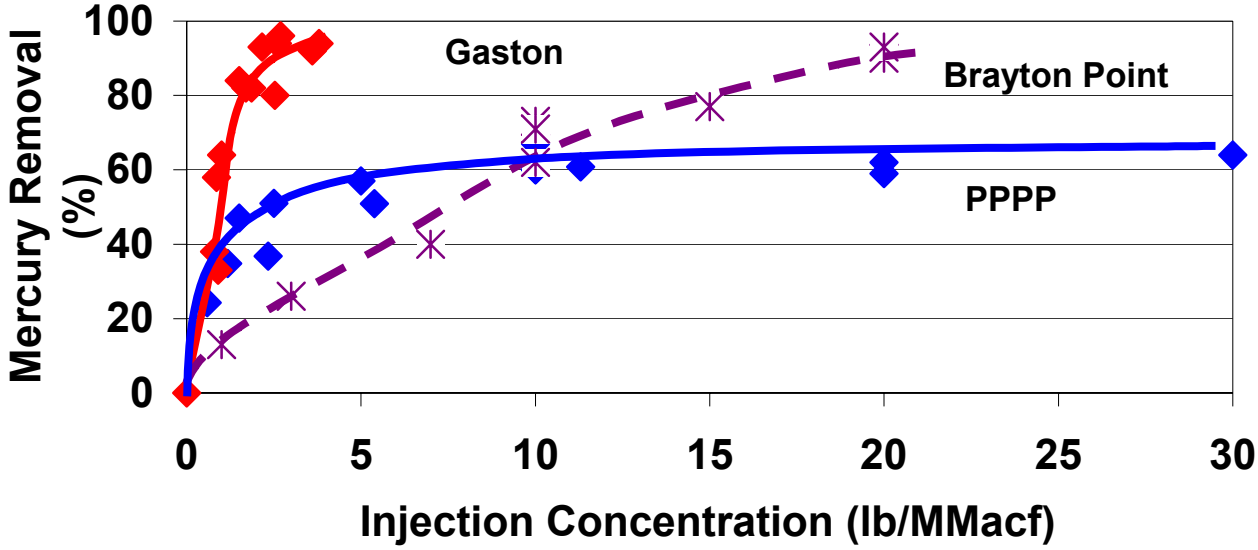
With respect to both the removal trend and the sorbent costs, preliminary results for Brayton Point indicate that the higher the amount of sorbent injected, the more mercury removed, with the highest removal values during long term tests ranging from 90-93% at the highest sorbent injection rate of 20 lb/MMacf. In contrast to the other two facilities for which data are available, Brayton Point does not exhibit a sorbent injection level at which further injection of sorbent provides no further mercury removal; instead, addition of more sorbent results in additional mercury reductions over the range of sorbent injection levels tested, with an approximately linear trend. The trends in Chart 4 suggest that mercury removal efficiencies even higher than 90-93% would be feasible at Brayton Point, in contrast to the other two facilities tested which display a distinct "knee" to the carbon injection curve, above which further carbon injection results in little additional mercury removal.

Physically retrofitting carbon injection hardware is a straightforward undertaking. Both Brayton Point and Salem Harbor installed full-scale activated carbon pilot testing equipment for these studies, which was subsequently removed at the end of testing.

These results are preliminary, and DOE's prime contractor in this study has indicated that extended operation of the sorbent-injection-based system would be needed to determine if there are negative impacts of sorbent injection on downstream hardware. DOE's contractor has estimated that the "first commercial installations at a few early adopters" could occur in 2005-2007.[16] These preliminary results of DOE-funded field tests demonstrate successful application of mercury-specific control technology at mercury removal levels greater than 90%; thus, control of mercury using mercury-specific control technology is technologically feasible.

[16] "Status of Sorbent Injection Mercury Control Technology," Testimony before the US Senate Committee on Environment and Public Works, Michael D. Durham, ADA Environmental Solutions, January 29, 2002.

Chart 4. Mercury Removal Trends With Sorbent Injection



d. COHPAC Experience

Further demonstration of the feasibility of mercury control comes from the experience with fabric filter technology (in particular the Electric Power Research Institute's patented COmpact Hybrid PArticulate Collector (COHPAC) baghouse system). Because mercury adsorbs onto particulate matter, mercury removal can be improved by collecting a larger portion of flue gas particulate matter. A fabric filter typically removes far more mercury than an electrostatic precipitator; this is due to: 1) increased contact between flue gas and particulate matter on the filter itself, providing additional opportunity for flue gas mercury to adsorb onto particulate matter, and 2) increased collection of the particulates to which mercury has adsorbed.

The SEMASS Municipal Waste Combustor (MWC) facility in Rochester, Massachusetts conducted pilot scale testing of COHPAC for a year starting in April 1998 and subsequently installed COHPAC on units 1 and 2 in order to achieve the standards established by the Massachusetts MWC regulation 310 CMR 7.08(2). The pilot testing was initially intended only to assess particulate removal, but the scope was ultimately enlarged to evaluate carbon injection at two boiler locations. Installation of COHPAC saved the municipalities contracting with the MWC for trash disposal an estimated $10,000,000[17] by avoiding the installation of conventional baghouses on units 1 and 2.

The COHPAC technology has been in use to control opacity on two units at Alabama Power's Gaston facility[18] (since December 1996 on unit 3 and since June 1999 on unit 2), showing that the technology has been successfully transferred to the electric power industry. A "sorbent injection plus COHPAC" configuration was also used at Alabama Power's Gaston station during DOE-funded sorbent-injection tests as discussed above in "Field Tests of Mercury Specific

[17] Estimated by SEMASS.
[18] "COHPAC (COmpact Hybrid PArticulate Collector): The Next Generation in Particulate Control Technology, Alabama Power Company's E.C. Gaston Units #2 and #3, 'A Success Story'" Miller, Richard et al.

Controls." The increased contact between flue gas mercury and sorbent provided by sorbent caught on the fabric filter means that less sorbent must be injected to achieve a given level of mercury control than is required for a facility equipped only with an ESP, thereby reducing costs.

Fabric filter-based particulate control technology, which will increase mercury removal, has been successfully transferred to the electric power industry; thus, Massachusetts DEP believes control of mercury at power plants using equipment originally designed for particulate removal is technologically feasible.

e. MWC Source Sector Mercury Reductions

Carbon injection systems are widely used in Massachusetts and other states to achieve mercury removal from Municipal Waste Combustors, providing a wide base of practical experience with manufacture of sorbents, installation, and material handling, demonstrating that this control technology is technologically feasible. Four of 11 Massachusetts municipal waste combustor units are currently achieving a 95% or greater mercury removal rate using activated carbon injection technology, demonstrating that a removal efficiency of 95% is currently achievable. The remaining units are all achieving an 89% or greater removal rate.

3. Economic Feasibility of Mercury Controls

The proposed regulation is structured to allow the affected facilities to determine whether the SO2 and NOx controls approved for the facility will also achieve mercury reductions sufficient to preclude the need for installation of additional mercury controls. If planned SO2 and NOx controls do not achieve the proposed phase 2 mercury standard, the most likely control technology to be installed is Activated Carbon Injection (ACI). In fact, Brayton Point and Salem Harbor are already planning for possible ACI installation, leaving space to accommodate hardware installation.

Available data indicate that achieving >90% control is feasible. In addition, the Department expects that significant gains in technology will be made by the compliance date for the phase 2 mercury standard in 2012.

EPA has demonstrated that various levels of mercury control are economically feasible, including a 90% control level. EPA's projected costs for sorbent-injection based systems, which most likely will reach commercialization for mercury control before other technologies, are similar to those seen and accepted for control of NOx in the electric power industry

The Department estimates that were the Massachusetts facilities to choose to install ACI, costs for silos, feeders, blowers and associated hardware, based on a recent 750 megawatt (MW) ACI bid of ~$1.6 million, could be as follows:

- Salem Harbor's consolidated flue gas handling system costs (adding Salem Unit 1 at 84 MW, Salem Unit 2 at 81 MW, and Salem Unit 3 at 150 MW for a total of 315 MW) would scale to ~$672,000.
- Mt. Tom at 147 MW would scale to ~$313,600.
- Brayton Point is installing a consolidated ash handling system designed to remove 95% of mercury in the ash from units 1, 2, and 3, with a heat input of 97 mmBtu/hour. If ACI were installed on this ash system, hardware costs cannot be scaled directly from the 750

MW bid above because the ash system is so small; therefore, an estimate of $100,000 is likely the correct order of magnitude.

Activated carbon costs ~$0.50 per pound, depending on where purchased and quantity needed. The amount of carbon needed depends on the mercury removal that can be achieved by the new SO2 and NOx controls. It is possible that facilities will achieve the mercury standards without needing to inject any carbon. If carbon were needed to reduce the entire 57-59 pounds per year of mercury required for 95% removal, rather than 85% removal (see Charts 1 and 2), some 119,000 pounds of carbon would be needed, at a cost of $60,000. This equates to an approximate cost of $1,000 of carbon per pound of mercury removed. This cost range can be compared, for example, to the $2,000 cost/ton of pollutants (NOx, CO, NMOC) removed incurred by the LEV II regulation, or as documented in a 1998 NESCAUM/MARAMA report which found approximate annual coal unit retrofit control costs of $825-1,525/ton for reductions to NOx emissions levels similar to that required by 310 CMR 7.29. Even if 10 times more carbon were needed, the additional annual cost would amount to less than $1 million.

Future costs for mercury controls are expected to decline for a number of reasons, including the following:

- The development of more cost-effective particulate control devices, such as COHPAC;
- Development of more effective sorbents, such as composite powdered activated carbon (PAC) lime;
- Economies of scale related to more widespread use of sorbents at additional MWCs and coal-fired facilities;
- Development of cheaper raw materials for the manufacture of sorbents; and
- Use of ultra fine sorbents with a higher surface area, which allow for use of less sorbent.

Improved methods for controlling mercury and multi-pollutant emissions are under development by DOE, EPA, EPRI, the electric industry, and control technology vendors. As a result of these research and development activities, mercury and multi-pollutant control options are expected to become available with improved cost-effectiveness in the next few years.

The Department requests comment on:
The costs the affected facilities anticipate they would incur due to the proposed regulations.

B. Mercury Emission Caps

The existing 310 CMR 7.29(5)(a)3.c. requires "that beginning at the time of the affected facility's earliest applicable compliance date in 310 CMR 7.29(6)(c), total annual mercury emissions from combustion of solid fuels in units subject to Part 72 located at an affected facility will not exceed the average annual emissions calculated using the results of the stack tests required in 310 CMR 7.29(5)(a)3.d.ii.." The amendments proposed here provide more detail on calculation of these mercury "caps." The calculation multiplies the average pounds of mercury per million British thermal units (mmBtu) measured during the stack tests required in 310 CMR 7.29(5)(a)3.d.ii. times a three-year average heat input in mmBtu. Using the same three baseline years for each facility as were selected in calculating the existing CO2 emissions caps, the resulting annual mercury caps, in <u>pounds of mercury per year</u>, would be:

Brayton Point Station	146.6
Mt. Tom Station	4.1
Salem Harbor Station	21.2
Somerset Station	13.1
Total	185.0

As with the caps on CO2 emissions, the Department will propose incorporating these caps into each facility's 310 CMR 7.29 Emission Control Plan approval.

The Department requests comment on:
Whether the new options for calculating mercury caps are appropriate.

C. Ash re-burn

The proposed regulation at 7.29(5)(a)3.c. requires facilities to include the mercury from coal ash that is re-burned in Massachusetts when reporting the facility's total mercury emissions.

At least two Massachusetts facilities are planning to re-burn ash on-site, capturing the energy of the carbon remaining in the ash. The most commonly discussed off-site ash re-burn options include cement kilns and asphalt batching plants. When coal ash containing mercury is heated to high temperatures, mercury is volatilized.[19] The proposed provision ensures that if mercury in ash or activated carbon from an affected facility is re-released in Massachusetts, the emissions will be accounted for. Therefore, the Department is proposing to require solid fuel-fired facilities subject to 310 CMR 7.29 to include mercury emissions associated with re-burn of ash in Massachusetts in the emissions report due in January of each year, for meeting both the mercury emissions cap and the applicable mercury emissions standard.

The Department requests comment on:
Whether mercury emissions from ash re-burn in Massachusetts should be included when calculating a facility's emissions.

D. Alternative Reduction Plan

The proposed regulations include an interim option for subject facilities to apply for an alternative reduction plan. This option is offered until December 31, 2009 in order to allow facilities time to optimize their SO2 and NOx controls for mercury removal. The proposed regulation offers two alternatives to facilities subject to the mercury provisions of 310 CMR 7.29:

- Facilities could seek out opportunities to reduce mercury air emissions from other Massachusetts facilities

- Facilities could reduce potential air emissions in Massachusetts by, for example, arranging for the collection and recycling of mercury from high school chemistry labs or dentists' offices. Because such mercury would only potentially become air emissions (e.g., were a school to experience a fire), DEP is proposing that such reductions could

[19] "Characterization and Management of Residues from Coal-fired Power Plants," USEPA Office of Research and Development, EPA-600/R-02083, December 2002.

only be applied on a two for one basis, e.g., one pound credited for every two pounds reduced.

A facility wishing to use alternative reductions toward compliance with the mercury emissions standards in 310 CMR 7.29(5)(a)3.e. and f. would indicate such in the January 30th report required annually by 310 CMR 7.29(7).

It is possible that a facility could meet the emissions standards in the regulations, and yet exceed the mercury emissions cap discussed above in section III.B. The proposed regulations, in keeping with the current regulation, do not allow alternative reductions to be used to comply with a facility's mercury cap, i.e., actual site emissions must not exceed the cap. The Department requests comment on whether alternative reductions should be credited towards compliance with a facility's mercury emissions cap.

The Department also requests comment on the following question concerning potential application of alternative reductions. In a case where a facility meets neither the emissions standards nor the mercury emissions cap, should a single pound of alternative reduction be credited toward compliance with both requirements?

Currently, there is no national mechanism for the permanent storage of mercury. If such a mechanism becomes available in the future, the Department could encourage permanent storage by crediting collection and permanent storage on a one pound credited for every pound permanently stored.

The Department requests comment on:
Whether an alternative reduction option should be offered.
Whether alternative mercury reductions that occur through collection and recycling of mercury should be credited on a two pounds reduced for one pound credited, or credited at some other ratio.
Whether an alternative reduction option should be extended until the second phase mercury standard takes effect, i.e., in 2012, or until some later date.
Whether alternative reductions should be allowed to be used to meet a facility's mercury cap.
Whether alternative reductions should be credited towards compliance with a facility's mercury emissions cap, and if so, whether a single pound of alternative reduction can be credited toward compliance with both requirements (standard and cap).
Whether a project proponent should receive credit for alternative mercury reductions that occur through collection on a one for one basis when and if national mechanisms are developed for permanently storing mercury.

E. Mercury Continuous Emissions Monitors to Determine Compliance

The draft regulation requires owners of coal-fired units to apply for a monitoring plan approval and install mercury continuous emissions monitoring systems (CEMS) by January 1, 2008. If a CEMS is installed which does not measure particulate-bound mercury, then the particulate-bound mercury level measured during the most recent stack test must be added to the CEM readings to determine total mercury emissions.

The Department requests comment on:

Whether the requirement to use mercury CEMS is appropriate.
Whether the deadline for use of mercury CEMS is appropriate.
Whether total mercury should be required to be reported by using a combination of CEMS and stack test data.

F. Stack Testing Frequency

The proposed regulation requires facilities to test for mercury each calendar quarter. Once a facility complied with the mercury emission limit for each four calendar quarter period for two consecutive years, the proposed regulation allows the facility to elect to perform emissions testing in only four of every five calendar quarters. This approach is similar to that adopted for Massachusetts Municipal Waste Combustors.

The Department requests comment on:
Whether testing should be allowed less frequently once compliance has been demonstrated for some period of time.
What period of time compliance should be demonstrated for, before allowing less frequent testing.
Whether testing should be required in only four of every five calendar quarters, or at some other frequency.

IV. Request For Comments

As noted earlier in this document, DEP requests comments on the relative merits of DEP's proposed mercury standards for affected facilities. In particular, DEP requests comment on:

Whether the levels of the proposed mercury standards are appropriate.
Whether the compliance dates of the proposed mercury standards are appropriate.
Whether the Department should propose a two-phase approach, or some other approach.
Whether the 2001-2002 inlet levels should be used as the basis for calculating removal efficiency.
Whether the calculations detailed in the regulation are appropriate to determine compliance.
The costs the affected facilities anticipate they would incur due to the proposed regulations.
Whether the new options for calculating mercury caps are appropriate.
Whether mercury emissions from ash re-burn in Massachusetts should be included when calculating a facility's emissions.
Whether an alternative reduction option should be offered.
Whether alternative mercury reductions that occur through collection and recycling of mercury should be credited on a two pounds reduced for one pound credited, or credited at some other ratio.
Whether an alternative reduction option should be extended until the second phase mercury standard takes effect, i.e., in 2012, or until some later date.
Whether alternative reductions should be allowed to be used to meet a facility's mercury cap.
Whether alternative reductions should be credited towards compliance with a facility's mercury emissions cap, and if so, whether a single pound of alternative reduction can be credited toward compliance with both requirements (standard and cap).

Whether a project proponent should receive credit for alternative mercury reductions that occur through collection on a one for one basis when and if national mechanisms are developed for permanently storing mercury.
Whether the requirement to use mercury CEMS is appropriate.
Whether the deadline for use of mercury CEMS is appropriate.
Whether total mercury should be required to be reported by using a combination of CEMS and stack test data.
Whether testing should be allowed less frequently once compliance has been demonstrated for some period of time.
What period of time compliance should be demonstrated for, before allowing less frequent testing.
Whether testing should be required in only four of every five calendar quarters, or at some other frequency.

In addition, DEP solicits comments on any of the provisions set forth in this proposal.

V. Agricultural Impacts

Pursuant to the intent of Massachusetts General Laws, Chapter 30A, Section 18, state agencies must evaluate the impact of proposed programs on agriculture within the Commonwealth.

The proposed amendments to add a mercury standard to the Emission Standards for Power Plants regulation are not expected to have any negative impacts on agricultural production in Massachusetts. Positive benefits to fisheries production may eventually accrue from reduced mercury levels in fish, by allowing the lifting of bans on consumption of freshwater fish.

VI. Impact on Massachusetts Municipalities, Proposition 2½

The proposed amendments to the regulation will not negatively impact cities or towns, as no affected facility is owned by a municipality.

VII. Massachusetts Environmental Policy Act

This proposed action is "categorically exempt" from the "Regulations Governing the Preparation of Environmental Impact Reports," 301 CMR 11.00, because the proposed regulation will result in reduced levels of emissions. All reasonable measures have been taken to minimize adverse impacts.

VIII. Impacts on Other Programs

A. Toxics Use Reduction

Implementation of toxics use reduction is a DEP priority. Toxics use reduction is defined as in-plant practices that reduce or eliminate the total mass of contaminants discharged to the

environment. The proposed amendments to 310 CMR 7.29, Emissions Standards for Power Plants, will assist this effort since mercury is a toxic pollutant.

B. Air Toxics

In the past, air pollution control programs have focused on the six criteria pollutants: particulate matter, nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide, and lead. Recently, concern has been raised over certain components of air pollution that are not specifically regulated by programs developed to control criteria pollutants. These compounds are collectively known as air toxics. The health effects of air toxics are wide-ranging and can vary from long-term carcinogenic effects to short-term adverse health effects.

The Clean Air Act requires EPA to promulgate control strategies for sources of toxic air emissions, such as mercury. DEP implements those standards as EPA promulgates them. In addition, DEP controls air toxics through programs aimed at controlling the traditional criteria pollutants. The proposed amendments to the regulation are expected to result in a reduction in mercury emissions from the affected facilities, as detailed in this document.

IX. Public Participation

In developing this regulation, DEP consulted with the Division of Energy Resources and the Department of Telecommunications and Energy. DEP also consulted with stakeholders, including affected facilities, environmental groups, industry groups, Massachusetts state agencies, other states and EPA. Their input helped DEP shape its proposal to consider various viewpoints.

The proposed amendments to 310 CMR 7.29 are subject to public review and comment prior to finalization and promulgation. After public review, and DEP evaluation of and response to any comments, the final regulation will be submitted to the Secretary of the Commonwealth for promulgation. DEP plans to submit the final 310 CMR 7.29 regulations to EPA as a revision to the Massachusetts State Implementation Plan at some point in the future.

As required by state law, DEP must give notice and provide the public at least 21 days after publishing the notice of the proposed amendments the opportunity for a public hearing and to provide comment. To assure more adequate notice for processing an amendment to the SIP and to comply with federal notice requirements, a formal notice is issued 30 days before the public hearings. Public hearings to collect comments on the proposed 310 CMR 7.29 revisions will be conducted under the provisions of M.G.L. Chapter 30A on:

Date: November 13, 2003 at 7:00 p.m.
Salem Maritime National Historic Site, Regional Visitor Center
2 New Liberty St.
Salem, Massachusetts

Date: November 13, 2003 at 7:00 p.m.
Holiday Inn
245 Whiting Farms Rd.
Holyoke, Massachusetts

Date: November 19, 2003 at 7:00 p.m.
City Council Hearing Room, City of Fall River
One Government Center
Fall River, Massachusetts

Testimony may be presented orally or in writing at the public hearings. Written comments will be accepted until 5:00 p.m. on Monday, December 8, 2003. Please submit written comments to:

Sharon Weber
Department of Environmental Protection
Bureau of Waste Prevention
37 Shattuck Street
Lawrence, MA 01843-1398
Attention: Mercury Comments

If possible, please e-mail a copy to sharon.weber@state.ma.us

To ensure that your written comments are included in the hearing docket, please make sure that you address your comments to Sharon Weber. Comments sent to other offices may not be received in time to be included in the official docket.

If there are any questions regarding this document, please contact Sharon Weber, sharon.weber@state.ma.us, at DEP's Lawrence Office, Bureau of Waste Prevention or Susan Ruch, susan.ruch@state.ma.us, at DEP's Boston Office of General Counsel.

Appendix A. Proposed regulatory revisions to 310 CMR 7.29

Appendix B. 310 CMR 7.29 Emission Control Plan Summaries For Coal-Fired Units

For reference, the pollution control measures listed in the 310 CMR 7.29 Emission Control Plan (ECP) approvals issued June 7, 2002 for the coal-fired Massachusetts units subject to 310 CMR 7.29 are summarized below. Also included are the controls indicated in the Administrative Consent Order for Salem Harbor.

Key Highlighted text in the second column indicates new equipment or a new pollution control technique expected to be installed or utilized. Plain text indicates existing equipment or an existing pollution control technique.

Facility Name	Emission Control Plan Summary
Holyoke Water Power Company Mt. Tom Station	Single Unit Facility Proposed Pollution Control Technique(s): Management of Lower Sulfur Fuels (Conversion to cleaner Coals) Upgraded combustion controls and burner system – NO_x control Selective Non-Catalytic Reduction – NO_x control Electrostatic Precipitators – PM control SO_2 Early Reduction Credits SO_2 Acid Rain Allowances Off-site CO_2 Reductions
PG&E Salem Harbor Station	Multi Unit Facility Proposed Pollution Control Technique(s): **Units 1, 2 and 3** – Low NO_x Burners Selective Catalytic Reduction – NO_x control Combustion Tuning and Controls – NO_x control Electrostatic Precipitators – PM control Management of Lower Sulfur Fuels Dry Flue Gas Desulfurization with Fabric Filter – SO_2 controls

PG&E Brayton Point Station	Multi Unit Facility Proposed Pollution Control Technique(s): **Unit 1** – Selective Catalytic Reduction – NO_x control Ash Reduction Process Electrostatic Precipitators – PM control Low NO_x Burners with Overfire Air Management of Lower Sulfur Fuels **Unit 2** – Ash Reduction Process Electrostatic Precipitators – PM control Low NO_x Burners with Overfire Air Management of Lower Sulfur Fuels EPRICON Flue Gas Conditioning – SO_2 control **Unit 3 –** Selective Catalytic Reduction – NO_x control Ash Reduction Process Electrostatic Precipitators – PM control Low NO_x Burners with Over fire Air Management of Lower Sulfur Fuels Wet Flue Gas Desulfurization – SO_2 control A new taller stack
NRG Somerset Station	Single Unit Facility Proposed Pollution Control Technique(s): Natural Gas Reburn Management of Lower Sulfur Fuels (Reduced sulfur coal) Selective Non-Catalytic Reduction – NO_x control Overfire Air Ports – NO_x control Electrostatic Precipitators – PM control SO_2 Early Reduction Credits SO_2 Acid Rain Allowances Off-site CO_2 Reductions On-site CO_2 Reductions